Distribution of Recoveries of Steller's Eiders Banded on the Lower Alaska Peninsula, Alaska (Distribución de los Recobros de Individuos de Polysticta stelleri Anillados en la Parte Inferior de la Península de Alaska, Alaska)

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DISTRIBUTION OF RECOVERIES OF STELLER'S EIDERS BANDED ON THE LOWER ALASKA PENINSULA, ALASKA

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Abstract.—Molting adult Steller's Eiders (*Polysticta stelleri*) were banded at Izembek Lagoon (1961–1998) and Nelson Lagoon (1995–1997) along the lower Alaska Peninsula to determine breeding distribution and movements. Of 52,985 Steller's Eiders banded, 347 were recovered. The overall low recovery rate may not be indicative of harvest levels but may be due to low reporting rates of bands. Almost all recoveries during summer were from Russia and recovery rates did not differ between sexes. We found no evidence that Steller's Eiders molting in specific locations were more likely to be recovered in specific geographic locations in Russia. Our recoveries suggest that Steller's Eiders molting along the Alaska Peninsula were from Russian breeding sites and from remnant breeding populations in Alaska.

DISTRIBUCIÓN DE LOS RECOBROS DE INDIVIDUOS DE *POLYSTICTA STELLERI* ANILLADOS EN LA PARTE INFERIOR DE LA PENÍNSULA DE ALASKA, ALASKA

Sinopsis.—Adultos de *Polysticta stelleri* fueron anillados durante el periodo de muda en la laguna de Izembek (1961–1998) y la laguna de Nelson (1995–1997) a lo largo de la parte inferior de la Península de Alaska. Esto se hizo con el propósito de determinar los movimientos del ave y su distribución reproductiva. De 52,985 individuos anillados, se recobraron 347. La baja tasa de recobro pudiera ser un indicativo de la baja tasa de informes y no de la tasa de cosecho. Casi todos los recobros del verano fueron de individuos de Rusia y no se encontró diferencia entre sexos. No encontramos evidencia con respecto a que individuos que mudaron en localidades particulares fueran más propensos a ser recobrados en regiones específicas de Rusia. Nuestros recobros sugieren que las aves que mudan a lo largo de la Península de Alaska se reproducen en Rusia, con algunas individuos representantes de un remanente de las poblaciones residentes de Alaska.

The Steller's Eider (*Polysticta stelleri*) is a Holarctic species with distinct breeding sub-populations using Pacific and Atlantic wintering areas. Nesting occurs at low densities in remote habitats (Quakenbush et al. 1995). To date, only limited information on the biology of nesting Steller's Eiders is available (Quakenbush et al. 1995, Solovieva 1997), and data on population size and trends are speculative (Quakenbush and Cochrane 1993). Limited information suggesting reduced range and numbers resulted in the 1997 designation of the Alaska breeding population of Steller's Eiders as *threatened* under the provisions of the U.S. Endangered Species Act (Anonymous 1997). The Steller's Eider received a similar designation, a decade earlier, in the Yakutsk Republic, Russia (Solomonov 1987).

Most of the Pacific population breeds along 4600 km of Russian arctic coastline from the Chukotka Peninsula west to the Khatanga River (Dementiev and Gladkov 1952, Bellrose 1976, Palmer 1976, Kertell 1991). The center of nesting abundance is the Yakutsk Republic of the eastern Russian arctic, primarily from the Lena River east to the Kolyma River (Kistchinski 1973). Historically, the breeding range of the Steller's Eider in Alaska spanned the arctic coastal plain from Wainwright to Demarcation Point, and the coastline of the Yukon-Kuskokwim Delta (Gabrielson and Lincoln 1959, Kertell 1991, Quakenbush and Cochrane 1993, Flint and Herzog 1999, Quakenbush and Suydam 1999).

Many Pacific Steller's Eiders undertake a post-breeding molt migration to coastal southwest Alaska in July and August. Molting Steller's Eiders have been observed near headlands and in estuaries from Nunivak Island and the Yukon-Kuskokwim Delta (Dau 1987) to the southern Alaska Peninsula (Jones 1965). When flightless, they occur in dense concentrations and prefer shallow, protected estuaries. Izembek Lagoon and Nelson Lagoon along the southern Alaska Peninsula are two of the most important molting sites for the Pacific population of Steller's Eiders (Jones 1965, Petersen 1980, 1981, Metzner 1993). Banding programs were begun at these estuaries in 1961 and 1995, respectively, to determine the temporal and spatial distribution of these birds and to begin to understand factors affecting population dynamics (Jones 1965, Flint et al. 2000). Flint et al. (2000) examined rates of annual survival and site fidelity of molting Steller's Eiders based on live recaptures of banded birds on molting areas and reported high rates of site fidelity (>95%) to specific molting areas within lagoons. However, it is unknown if these molting concentrations represent distinct breeding sub-populations and further information on linkages between molting and breeding distributions is required to fully interpret their results. Jones (1965) banded Steller's Eiders at a single location in Izembek Lagoon and reported that most recoveries (16 of 17) occurred in Siberia. However, a few recoveries from a single banding location are insufficient to determine sub-population structure. The goal of this paper is to describe the distribution of recoveries from Steller's Eiders banded at five different locations within two lagoons. We discuss these results in terms of recovery rates and linkages between molting and breeding populations.

METHODS

Izembek (55°20′N, 162°50′W) and Nelson (56°00′N, 161°20′W) lagoons are shallow estuaries along the Bering Sea side of the southern Alaska Peninsula (Fig. 1). They are protected by long, narrow and partially vegetated barrier islands or spits. Although numbers vary seasonally and annually, approximately 23,000 Steller's Eiders molt at Izembek Lagoon, with an additional 40,000 molting at Nelson Lagoon (Laubhan and Metzner 1999, C. P. Dau, unpubl. data).

Steller's Eiders were captured during late August and September between 1961 and 1997 (Table 1). Using 2–4 boats, birds were driven along

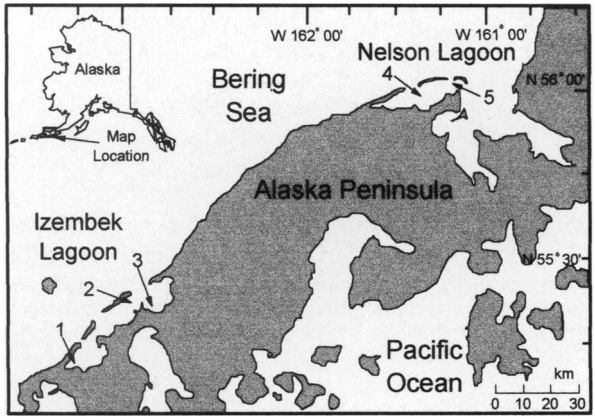

FIGURE 1. Map of the lower Alaska Peninsula including banding areas.

tide channels and captured in corral traps (Flint et al. 2000). Birds were held in the traps until banded, then released individually into the lagoon. While specific banding sites varied, Steller's Eiders were captured in three distinct areas at Izembek Lagoon and two areas at Nelson Lagoon (Fig. 1). The sex ratio of birds captured varied among banding locations (Flint et al. 2000).

We obtained band recovery information from (1) the U.S. Bird Banding Laboratory, Patuxent, Maryland, (2) information reported directly to the banding permit holder (i.e., Izembek National Wildlife Refuge), and (3) the Ringing Centre, Moscow, Russia. Essentially all recoveries were reported as harvested by subsistence hunters. We developed a simple model to compare recovery rates between sexes. We estimated recovery rate as the number of recoveries in a given year, divided by the estimated number of banded birds alive during that year. We used two different sets

TABLE 1. Number of Steller's Eiders banded by location and sex at Izembek Lagoon and Nelson Lagoon, Alaska, 1961–1997.

	Izembek Lagoon						Nelson Lagoon			
	1[a]		2		3		4		5	
Years	F	M	F	M	F	M	F	M	F	M
1961–1966	271	566								
1968	60	85								
1974–1981	3576	2197								
1984	0	0	119	246						
1991–1997	5971	708	6083	8281	984	19	4220	6367	2925	10,452
Totals	9818	3471	6202	8527	984	19	4220	6367	2925	10,452
	13,289		14,729		1003		10,587		13,377	

[a] Numbers refer to banding locations identified on Figure 1.

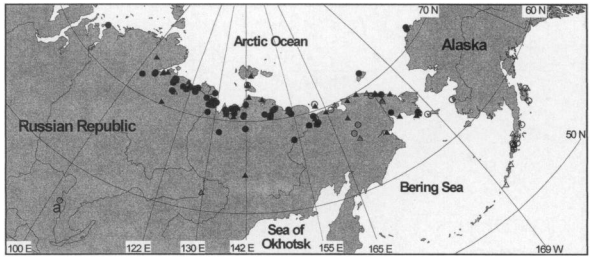

FIGURE 2. Locations of Steller's Eider recoveries from 1961–1998. Males are represented by ▲, females by ●, solid symbols are June and July recoveries (i.e., breeding season), and open symbols are the remainder of the year. An additional recovery of a male near Cambridge, Maryland, USA is not plotted. Recovery location designated by the letter *a* is questionable.

of assumptions for estimating the number of banded birds alive at a specific time. First, we assumed that all annual mortality occurred prior to any recoveries and estimated the number of banded birds alive as the number estimated to be alive the previous year plus the number of new birds banded; we then multiplied this sum by the annual survival rate. Alternatively, we assumed that all annual mortality occurred after all recoveries and estimated the number of banded birds alive as the number alive the previous year multiplied by the annual survival rate; we then added the number of birds banded the previous year to this product. Annual survival rates were taken from Flint et al. (2000). Based on these two sets of assumptions, we estimated the recovery rates for each sex in each year (1961–1998). Differences in recovery rates were compared between sexes using a paired *t*-test across years.

We assigned individual recoveries to groups based on recovery locations. Groups were arbitrarily defined based on geography and known breeding distributions (Table 2, Fig. 2). We compared the geographic distribution of recoveries within Russia (across the six areas with >1 recoveries) among the five banding areas using contingency table analyses. We restricted this analysis to bands recovered after 1990 because eiders were banded in only one area prior 1991 and inclusion of recoveries prior to 1990 required the assumption of constant recovery/reporting rates through time. We considered sexes separately in these analyses to control for potential differences in rates of site fidelity and/or sub-population structure.

RESULTS

Of 29,021 Steller's Eiders banded at Izembek Lagoon (Table 1), 285 were recovered (Table 2). Males made up 58.6% of the total banded and 44.5% of recoveries from Izembek Lagoon. Of 23,964 banded at Nelson Lagoon (Table 1), 62 were recovered (Table 2). Males made up 70.2% of the total banded and 79.0% of the total recovered from Nelson Lagoon. Most (81.8%) birds were recovered from the Russian coast (Table

TABLE 2. Locations of recoveries of Steller's Eiders banded at Izembek Lagoon and Nelson Lagoon, Alaska from 1961–1998.

Recovery location	Banding location			
	Izembek Lagoon		Nelson Lagoon	
	Females	Males	Females	Males
Russia				
<100°E (West of Taymyr River)	0	0	1	0
100°–122°E (Taymyr and Olenek Rivers)	40	26	6	31
122°–130°E (Lena River)	20	15	2	9
130°–142°E (Yana River)	23	15	2	1
142°–155°E (Khromskaya and Indigirka Rivers)	20	17	0	1
155°–165°E (Kolyma River)	10	9	1	0
165°E–169°W (Chukotka)	11	19	0	1
Unknown recovery location in Russia	3	1	0	0
Totals (Russia)	127	102	12	43
Alaska				
Wainwright to Demarcation Point	2	0	0	0
Point Hope to Cape Newenham	2	2	0	1
Cape Newenham to Kodiak Island[a]	26	23	1	5
Totals (Alaska)	30	25	1	6
Extralimital Recoveries	1	0	0	0
Totals (all sites)	158	127	13	49

[a] Total includes 13 females and 15 males killed during banding drives in 1978 and 1979 or collected in conjunction with a food habits study in 1980 (Metzner 1983).

2, Fig. 2). Both eastern Russian and Alaskan breeding Steller's Eiders were represented in the birds we banded. Additionally, in 1994, we recaptured one male that was originally banded near Barrow, Alaska (71°18′N, 156°40′W). We also recaptured one female and two males in 1995 and one female in 1996 that were originally banded on the Lena River Delta (71°42′N, 128°55′E). The mean recovery rate (% ± SD) across years of males ($\bar{x} = 0.5 \pm 0.5$) was not different than females ($\bar{x} = 0.5 \pm 0.6$), regardless of assumptions about timing of annual mortality ($t < 0.30$, df = 36, $P > 0.76$). We found no evidence that Steller's Eiders molting in a particular site were more likely to be recovered in a certain region in Russia (males: $\chi^2 = 25.5$, df = 20, $P = 0.2$, females: $\chi^2 = 19.9$, df = 20, $P = 0.5$).

DISCUSSION

Because Steller's Eiders have high inter-annual fidelity to specific molting areas, we hypothesized that birds molting in specific locations could be from unique breeding areas; under these conditions, molting populations would represent unique sub-populations. However, we found no evidence that Steller's Eiders banded in a specific molting location were more likely to be recovered in a given breeding location. This result is similar to that reported by Bollinger and Derksen (1996) for molting Black Brant (*Branta bernicla nigricans*) where individuals showed high

fidelity to specific molting areas; yet brant molting in specific areas were from many breeding locations. Thus, we suggest that eiders molting in a specific location likely represent birds from multiple breeding areas and we conclude that there was no sub-population structuring for Steller's Eiders molting along the Alaska Peninsula.

Adult female Steller's Eiders have higher annual survival rates than males (Flint et al. 2000), which is unusual for waterfowl (Johnson et al. 1992). We sought to test the hypothesis that differential harvest rates between sexes was contributing to this pattern of survival. In order for differential harvest to be causing a 15% reduction in annual survival of males compared to females, substantial harvest must be occurring (i.e., >10,000 individuals) and this harvest must be focused almost entirely on males. Thus, if harvest was reducing the survival of males compared to females, we would expect differences in band recovery rates between sexes. However, recovery rates were not different between sexes after controlling for annual survival and we conclude that there is no evidence that differential harvest is contributing to the relatively lower survival of male Steller's Eiders.

We believe the low recovery rates of our bands are not representative of harvest levels and are likely related to status of the species and type of hunting (i.e., subsistence as opposed to sport). Band recoveries may not be reported because the species is protected throughout most of its range. Under the provisions of the U.S. Endangered Species Act, any take of a threatened species is prohibited. Similar protection resulted from the Russian listing of the Steller's Eiders in the Yakutsk Red Book. Therefore, hunters may fail to report bands from harvested birds due to fear of prosecution. In general, band reporting rates have traditionally been low among subsistence hunters (Wolfe et al. 1990). Thus, we suggest that the low recovery rate of bands is likely related to reporting rate and the level of harvest cannot be inferred from our recovery rates.

In general, almost all of our recoveries were within the known range of Steller's Eiders (Fig. 2). We believe the distribution of June and July recoveries along 4600 km of Russian arctic coastline represents the geographic breeding range of the Pacific population of Steller's Eiders in Russia (Fig. 2). However, some of these recoveries during August and September may be birds shot during migration. Several recoveries inland in Siberia are unique and may be indicative of overland migration routes. Coastal breeding species such as Black Brant (Rakhilin 1972, Kistchinski and Vronski 1979) and King Eiders (*Somateria spectabilis*) (Konyukhov 1988) have been observed during overland migrations between the Sea of Okhotsk and arctic nesting areas. We suggest that some Steller's Eiders may follow a similar pattern, which would explain most of the inland recoveries (Fig. 2). The single recovery near Lake Baikal (Fig. 2a) is not within a likely migration corridor and we consider this to be a questionable recovery location. The two recoveries from the Barrow area where the species is a common and regular breeder (Quakenbush and Suydam 1999), do not represent the extent of their distribution in arctic Alaska

(King and Brackney 1997). Steller's Eider are now rare breeders within their historic range on the Yukon-Kuskokwim Delta in western Alaska (Kertell 1991, Flint and Herzog 1999) and only two recoveries have been reported near there, both in fall and likely migrants. However, a female banded at Izembek Lagoon was observed nesting on the Yukon-Kuskokwin Delta in 1997 and 1998 (Flint and Herzog 1999). The small size of the Alaskan breeding population combined with low harvest levels and rates of band reporting may explain the lack of recoveries within Alaska. Given the few recoveries, we believe our data are inconclusive with regard to molting segregation of the Alaskan breeding population. Additional marking of individuals on breeding areas within Alaska would be useful in determining the molting distribution for the Alaskan breeding population. The extralimital January recovery from Chesapeake Bay, Maryland, is likely the result of a single dispersal event as no other banded Steller's Eiders have been reported along the east coast of North America.

Although Steller's Eiders show high fidelity to specific molting areas along the Alaska Peninsula (Flint et al. 2000), our results suggest that each of these molting concentrations contains a mix of birds from different Russian breeding areas. Our results are less clear with regard to the Alaskan breeding birds. We conclude that there is no evidence for subpopulation structure among molting concentrations of Steller's Eiders along the Alaska Peninsula.

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